Amendments to the IPE Amended Claims

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (original) An inorganic-organic hybrid (IOH) which comprises:

(i) an expandable or swellable layered inorganic component; and

(ii) an organic component including at least one ionic organic component and one or more neutral organic components which are intercalated between and/or associated with the layer(s) of the inorganic component,

the ionic or neutral organic components being capable of decomposing or subliming endothermically, and/or releasing volatiles with low combustibility on decomposition and/or inducing charring of organic species during thermal decomposition or combustion.

2. (original) An IOH according to claim 1, in which the inorganic component is rendered positively or negatively charged due to isomorphic substitution of elements within the layers.

3. (currently amended) An IOH according to claim 1 ~~or claim 2~~, in which the inorganic component is selected from a 1:1 layered silicate structure, a 2:1 layered silicate structure, a double hydroxide of the general formula $Mg_6Al_{3.4}(OH)_{18.8}(CO_3)_{1.7}.H_2O$ and a synthetically prepared layered material.

4. (currently amended) An IOH according to ~~any one of claims 1 to 3~~ claim 1, in which the inorganic compound is a naturally occurring or a synthetic analogue of a phyllosilicate.

5. (original) An IOH according to claim 4, in which the naturally occurring or synthetic analogue of a phyllosilicate is a smectite clay.

6. (original) An IOH according to claim 5, in which the smectite clay is selected from montmorillonite, nontronite, beidellite, volkonskoite, hectorite, bentonite, saponite, sauconite, magadiite, kenyaite, laponite, vermiculite, synthetic micromica and synthetic hectorite.

7. (currently amended) An IOH according to claim 5 ~~or claim 8~~, in which the naturally occurring phyllosilicate is selected from bentonite, montmorillonite and hectorite.

8. (currently amended) An IOH according to ~~any one of claims 4 to 7~~ claim 4, in which the phyllosilicate has a platelet thickness less than about 5 nanometers and an aspect ratio greater than about 10:1.

9. (original) An IOH according to claim 8, in which the aspect ratio is greater than about 50:1.

10. (currently amended) An IOH according to claim 8 ~~or claim 9~~, in which the aspect ratio is greater than about 100:1.

11. (currently amended) An IOH according to ~~any one of claims 1 to 10~~ claim 1, in which the inorganic component includes interlayer or exchangeable metal cations to balance the charge.

12. (original) An IOH according to claim 11, in which the metal cation is selected from an alkali metal and alkali earth metal.

13. (original) An IOH according to claim 12, in which the alkali or alkali earth metal is selected from Na^+, K^+, Mg^{2+} and Ca^{2+}.

14. (currently amended) An IOH according to ~~any one of claims 11 to 13~~ claim 11, in which the cation exchange capacity of the inorganic component is less than about 400 milli-equivalents per 100 grams.

15. (currently amended) An IOH according to ~~any one of claims 11 to 14~~ claim 11, in which the ionic organic component is exchanged with the exchangeable metal ions of the inorganic component.

16. (currently amended) An IOH according to ~~any one of claims 1 to 15~~ claim 1, in which the ionic species contains onium ion(s).

17. (original) An IOH according to claim 16, in which the ionic species containing onium ion(s) is an ammonium, phosphonium or sulfonium derivative of an aliphatic, aromatic or aryl-aliphatic amine, phosphine or sulfide.

18. (currently amended) An IOH according to ~~any one of claims 1 to 17~~ claim 1, in which the ionic or neutral organic component is a neutral or ionic derivative of a nitrogen based molecule.

19. (original) An IOH according to claim 18, in which the nitrogen based molecule is a triazine based species.

20. (original) An IOH according to claim 19, in which the triazine based species is selected from melamine, triphenyl melamine, melam (1,3,5-triazine-2,4,6-triamine-n-(4,6-diamino-1,3,5-

triazine-yl)), melem ((-2,5,8-triamino-1,3,4,6,7,9,9b-heptaazaphenalene)), melon (poly{8-amino-l,3,4,6,7,9,9b-heptaazaphenalene-2,5diyl)imino}), bis and triaziridinyltriazine, trimethylsilyltriazine, melamine cyanurate, melamine phthalate, melamine phosphate, melamine phosphite, melamine phthalimide, dimelamine phosphate, phosphazines, low molecular weight polymers with triazine and phosphazine repeat units and isocyanuric acid and salts or derivatives thereof.

21. (original) An IOH according to claim 20, in which isocyanuric acid and salts or derivatives thereof are selected from isocyanuric acid, cyanuric acid, triethyl cyanurate, melamine cyanurate, trigylcidylcyanurate, triallyl isocyanurate, trichloroisocyanuric acid, 1,3,5-tris(2-hydroxyethyl)triazine-2,4,6-trione, hexamethylenentetramine.melam cyanurate, melem cyanurate and melon cyanurate.

22. (currently amended) An IOH according to ~~any one of claims 18 to 21~~ claim 18, in which the organic component is a derivative of phosphoric acid or boric acid.

23. (original) An IOH according to claim 22, in which the derivative of phosphoric acid or boric acid is selected from ammonia polyphosphate, melamine polyphosphate and melamine phosphate ammonium borate.

24. (currently amended) An IOH according to ~~any one of claims 1 to 23~~ claim 1, in which the ionic organic component is used in combination with other ionic compounds which are capable of improving compatibility and dispersion between the inorganic and organic components.

25. (original) An IOH according to claim 24, in which the other ionic compound is an amphiphilic molecule that incorporates a hydrophilic ionic group along with hydrophobic alkyl

or aromatic moieties.

26. (currently amended) An IOH according to ~~any one of the preceding claims~~ claim 1, which further comprises one or more coupling reagents.

27. (original) An IOH according to claim 26, in which the coupling reagent is selected from an organically functionalised silane, zirconate and titanate.

28. (original) An IOH according to claim 27, in which the silane coupling reagent is tri-alkoxy, acetoxy or halosilanes functionalised with amino, epoxy, isocyanate, hydroxyl, thiol, mercapto and/or methacryl reactive moieties or modified to incorporate functional groups based on triazine derivatives, long chain alkyl, aromatic or alkylaromatic moieties.

29. (currently amended) A method for the preparation of the IOH defined in ~~any one of claims 1 to 28~~ claim 1, which comprises mixing components (i) and (ii) ~~defined in any one of claims 1 to 28~~ or constituents thereof in one or more steps.

30. (original) A method according to claim 29, in which mixing is achieved using melt, solution or powder processing.

31. (currently amended) A method according to claim 29 ~~or claim 30~~, in which the mixing is achieved using solution processing.

32. (currently amended) ~~Use of~~ A method for using the IOH defined in ~~any one of claims 1 to 28~~ claim 1 as a fire resistant material.

33. (currently amended) A fire resistant formulation which comprises:

(i) the IOH defined in ~~any one of claims 1 to 28~~ claim 1; and

(ii) one or more flame retardants.

34. (original) A formulation according to claim 33, in which the flame retardant is selected from phosphorus derivatives, nitrogen containing derivatives, molecules containing borate functional groups, molecules containing two or more alcohol groups, molecules which endothermically release non-combustible decomposition gases and expandable graphite.

35. (original) A formulation according to claim 34, in which the phosphorus derivatives are selected from melamine phosphate, dimelamine phosphate, melamine polyphosphate, ammonia phosphate, ammonia polyphosphate, pentaerythritol phosphate, melamine phosphite and triphenylphosphine.

36. (currently amended) A formulation according to claim 34 ~~or claim 35~~, in which the nitrogen containing derivatives are selected from melamine, melamine cyanurate, melamine phthalate, melamine phthalimide, melam, melem, melon, melam cyanurate, melem cyanurate, melon cyanurate, hexamethylene tetraamine, imidazole, adenine, guanine, cytosine and thymine.

37. (currently amended) A formulation according to ~~any one of claims 34 to 36~~ claim 34, in which the molecules containing borate functional groups are selected from ammonia borate and zinc borate.

38. (currently amended) A formulation according to ~~any one of claims 34 to 37~~ claim 34, in which the molecules containing two or more alcohol groups are selected from pentaerythritol, polyethylene alcohol, polyglycols and carbohydrates.

39. (currently amended) A formulation according to ~~any one of claims 34 to 38~~ claim 34, in which the molecules which endothermically release non-combustible decomposition gases are selected from magnesium hydroxide and aluminum hydroxide.

40. (currently amended) A method for the preparation of the fire resistant formulation defined in ~~any one of claims 33 to 39~~ claim 33, which comprises mixing ~~components (i) and (ii) as defined in anyone of claims 1 to 28~~ the following components or constituents thereof in one or more steps:

(i) an expandable or swellable layered inorganic component; and

(ii) an organic component including at least one ionic organic component and one or more neutral organic components which are intercalated between and/or associated with the layer(s) of the inorganic component,

the ionic or neutral organic components being capable of decomposing or subliming endothermically, and/or releasing volatiles with low combustibility on decomposition and/or inducing charring of organic species during thermal decomposition or combustion.

41. (original) A method according to claim 40, in which mixing is achieved using melt, solution or powder processing.

42. (currently amended) A method according to claim 40 ~~or claim 41~~, in which the mixing is achieved using melt processing in a twin screw extruder or batch mixer; or powder processing using a high shear powder mixer or milling procedures.

43. (currently amended)) A polyamide fire resistant formulation which comprises either:

(A) (i) the IOH defined in ~~any one of claims 1 to 28~~ claim 1; and

(ii) a polyamide based matrix; or

(B) (i) [[the]] a fire resistant formulation ~~defined in any one of claims 33 to 39~~ comprising the IOH defined in claim 1 and one or more flame retardants; and

(ii) a polyamide based matrix.

44. (original) A formulation according to claim 43, in which the polyamide based matrix comprises generic groups with repeat units based on amides selected from Nylon4, Nylon6, Nylon7, Nylon 11, Nylon12, Nylon46, Nylon66, Nylon 68, Nylon610, Nylon612 and aromatic polyamides and co-polymers, blends or alloys thereof.

45. (currently amended) A formulation according to claim 43 ~~or claim 44~~, in which the polyamide based matrix is selected from Nylon12, Nylon6 and Nylon66 and co-polymers, alloys or blends thereof.

46. (currently amended) A formulation according to ~~any one of claims 43 to 45~~ claim 43, which further comprises one or more additives.

47. (original) A formulation according to claim 46, in which the additives are selected from polymeric stabilisers; lubricants; antioxidants; pigments, dyes or other additives to alter the materials optical properties or colour; conductive fillers or fibers; release agents; slip agents; plasticisers; antibacterial or fungal agents; and processing agents.

48. (original) A formulation according to claim 47, in which the polymeric stabiliser is a UV, light or thermal stabilizer.

49. (currently amended) A formulation according to claim 47 ~~or claim 48~~, in which the

processing agents are selected from dispersing reagents, foaming or blowing agents, surfactants, waxes, coupling reagents, rheology modifiers, film forming reagents and free radical generating reagents.

50. (currently amended) A formulation according to ~~any one of claims 43 to 49~~ claim 43, in which the polyamide based matrix is Nylon12, Nylon6 and/or Nylon66; the IOH is montmorillonite or hectorite modified with melamine hydrochloride and/or melamine cyanurate hydrochloride and/or melamine and/or melamine cyanurate; and the flame retardant is melamine cyanurate and/or magnesium hydroxide; and the additive is a processing agent and/or a polymeric stabiliser.

51. (currently amended) A formulation according to ~~any one of claims 46 to 50~~ claim 46, in which the polyamide based matrix is present in an amount of about 45 to about 95% w/w, the IOH is present in an amount less than about 25% w/w and the flame retardant and/or additives are present in an amount less than about 30% w/w.

52. (currently amended) A formulation according to ~~any one of claims 46 to 51~~ claim 46, in which the polyamide based matrix is present in an amount greater than about 75% w/w, the IOH is present in an amount less than about 3% w/w, the melamine cyanurate flame retardant is present in an amount of about 11 to about 15% w/w and additives are present in an amount of about less than about 4% w/w.

53. (currently amended) A formulation according to ~~any one of claims 46 to 51~~ claim 46, in which the polyamide based matrix is present in an amount greater than about 75% w/w, the IOH is present in an amount less than about 3% w/w, the melamine cyanurate flame retardant is present in an amount of about 11 and about 15% w/w, magnesium hydroxide flame retardant

present in an amount of about 1 and about 5% w/w and additives are present in an amount less than about 4% w/w.

54. (currently amended) A method for the preparation of the polyamide fire resistant formulation defined in ~~any one of claims 43 to 53~~ claim 43, which comprises dispersing ~~the IOH as defined in any one of claims 1 to 28~~ an inorganic-organic hybrid (IOH) comprising:

(i) an expandable or swellable layered inorganic component; and

(ii) an organic component including at least one ionic organic component and one or more neutral organic components which are intercalated between and/or associated with the layer(s) of the inorganic component, the ionic or neutral organic components being capable of decomposing or subliming endothermically, and/or releasing volatiles with low combustibility on decomposition and/or inducing charring of organic species during thermal decomposition or combustion

~~or the fire resistant formulation defined in any one of claims 33 to 39 or constituents thereof~~ and optionally including one or more fire retardants into the polyamide based matrix in one or more steps.

55. (original) A method according to claim 54, in which at least some of the components are ground prior to mixing.

56. (original) A method according to claim 55, in which the components are ground to a particle size less than about 200 microns.

57. (currently amended) A method according to claim 55 ~~or claim 56~~, in which dispersion is achieved using melt, solution or powder processing.

58. (currently amended) A method according to ~~any one of claims 55 to 57~~ claim 55, in which the dispersion is achieved using melt processing in a single or twin screw extruder, batch mixer or continuous compounder.

59. (original) A method according to claim 58, in which the melt processing is conducted in a twin screw extruder.

60. (currently amended0 A method according to ~~any one of claims 54 to 59~~ claim 54, in which the dispersion occurs at a sufficient shear rate, shear stress and residence time to disperse the IOH at least partially on a nanometer scale.

61. (currently amended) A fire resistant article or parts thereof which is composed wholly or partly of the IOH as defined in claim 1 ~~any one of claims 1 to 28 and/or fire resistant formulation defined in any one of claims 33 to 39 and claims 43 to 53~~.

62. (original) A fire resistant article or parts thereof as defined in claim 61, which is used in transport, building, construction, electrical or optical applications.

63. (original) A fire resistant article or parts thereof as defined in claim 62, in which the transport application is air, automotive, aerospace or nautical.

64. (currently amended) A fire resistant article or parts thereof as defined in ~~any one of claims 61 to 63~~ claim 61, which is a hollow article or sheet.

65. (currently amended) A fire resistant article or parts thereof as defined in ~~any one of claims 61 to 64~~ claim 61 which is selected from pipes, ducts, fabric, carpet, cables, wires, fibres,

Environmental control systems, stowage bin hinge covers, cable trays, ECS duct spuds, latches, brackets, passenger surface units and thermoplastic laminate sheet.

66. (currently amended) A fire resistant hollow article or parts thereof which is composed wholly or partly of the fire resistant formulation defined in claim 52 ~~or claim 53~~ and manufactured by rotational moulding or extrusion.

67. (currently amended) A fire resistant fibre, fabric, carpet or parts thereof which is composed wholly or partly of the fire resistant formulation defined in claim 52 ~~or claim 53~~ and manufactured by melt spinning or extrusion.

68. (currently amended) A fire resistant article or parts thereof which is composed wholly or partly of the formulation defined in claim 52 ~~or claim 53~~ and manufactured by sintering.

69. (currently amended) A fire resistant article or parts thereof which is composed wholly or partly of the fire resistant formulation defined in claim 52 ~~or claim 53~~ and manufactured by injection or compression moulding.

70. (canceled)

71. (canceled)